NASA SBIR/STTR Technologies

T6.02-9946 - Improved Forecasts of Solar Particle Events using Eruptive Event Generators based on Gibson-Low and Titov-Demoulin Magnetic Configurations

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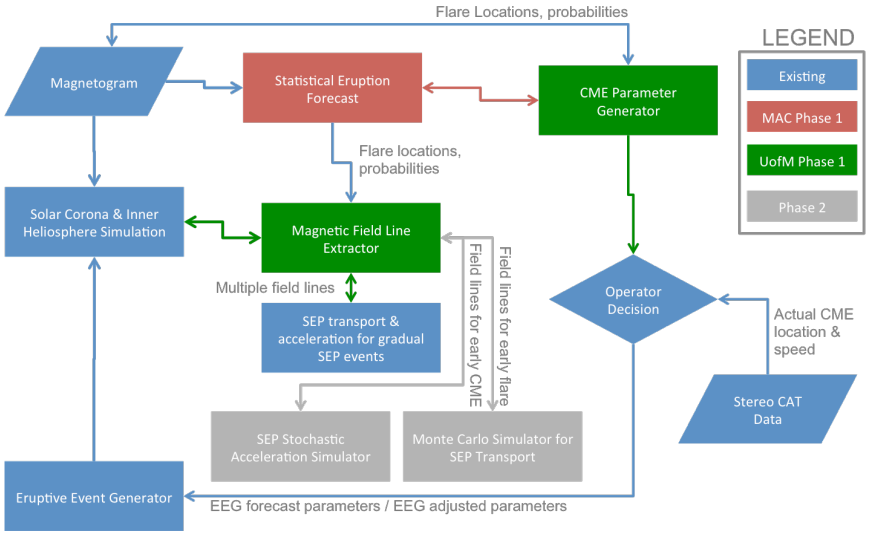
Identification and Significance of Innovation

Radiation hazards constitute a serious risk to human and robotic space operations beyond Low-Earth orbit. Primary contributors to space radiation include Solar Particle Events (SPEs) associated with Coronal Mass Ejections (CMEs). Solar energetic particles (SEPs) from these events adversely affect spacecraft components and can have an acute impact on human health.

The innovations proposed herein will allow operators to better predict Solar Particle Events by combining statistical solar eruption forecasts with modern magnetohydrodynamic simulations of coronal mass ejections, and simulations of particle transport along interplanetary magnetic fields. This will extend the forecast of radiation hazards from hours to days, allowing personnel to take preventative measures to attenuate potential risks, as well as develop effective mitigation strategies.



Estimated TRL at beginning and end of contract: (Begin: 6 End: 7)

Technical Objectives and Work Plan

The primary goal of this STTR is to improve the accuracy and extend the range of Solar Particle Event (SPE) forecasts, including the location, time, flux and energy distribution of the solar energetic particles associated with the events.

--TASK 1: To extend the forecasting of solar events to a 2-3 day period, we must first predict the likelihood of a solar eruption?there is not enough time, after a flare is observed, to properly simulate the accompanying radiation hazard. The objective of this task is to exploit existing statistical and data driven methods for forecasting the time and class of solar eruptions, and to make these predictions readily available to other software running within the Space Weather Modeling Framework at the at NASA's Community Coordinated Modeling Center (CCMC).
--TASK 2: We use observations of the solar magnetic field to drive simulations of coronal mass ejections (CMEs) associated with solar active regions. We will use two dominant models of CMEs for this: that of Gibson-Low and Titov-Demoulin, driven, in part, by real-time magnetogram measurements.
--TASK 3: In order to connect the magnetic field lines at the solar eruption site with sites near the Earth, we use the Alfv?n Wave Solar Model (AWSoM) which allows us to simulate the magnetic field topology from photospheric magnetic field measurements. Ultimately, this will allow us to

NASA Applications

The innovations developed on this program will help protect human and robotic space assets in and beyond low-Earth orbit, which are critical to NASA's mission.

Non-NASA Applications

In addition to human and robotic space operations, solar energetic particles disrupt civilian and DoD navigation, communication, and power systems. Understanding and predicting the dynamic space radiation environment will allow personnel to take preventative measures to attenuate potential risks, as well as develop effective mitigation strategies.

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